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Roles of Buffer Strips in Riparian Zones – TROLS Project U of A Update 1997/98

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DISCLAIMER

The study on which this report is based was funded by the Manning Diversified Forest Products Research Trust Fund, which is a component of the Government of Alberta's Environmental Protection and Enhancement Fund. The views, statements and conclusions expressed and the recommendations made in this report are entirely those of the author(s) and should not be construed as the statements, conclusions, or opinions of members of the Manning Diversified Forest Products Research Trust Fund Committee, the Government of Alberta, or the Alberta Forest Research Advisory Council.

ABSTRACT

Large scale harvesting of aspen-dominated forest is a new and rapidly expanding industry in the Canadian boreal forests. Very little, if any, research exists to indicate whether the width of riparian buffer strips left around lakes and streams during forest harvesting is consistent with sustainability of the aspen-dominated boreal forest. Beginning in early 1994, a project designed to study the impacts of various widths of buffer strips around lakes and streams commenced at the University of Alberta. The aim of this project was to leave various widths of buffer strips around lakes in the aspen-dominated boreal forest and study the effects on water quality, vegetation and wildlife. A stream component focuses on the effects of buffer width on stream ecology. There are 12 study lakes located in three study areas. Each area has four lakes, with each lake receiving one of the four buffer strip treatments: 20 m, 100 m, 200 m and 800 m. The stream study consists of five streams, with each stream receiving two harvest cutblocks along one edge: one block with a 30 m buffer and a second downstream block with a 0 m buffer. Harvesting of the experimental cutblocks occurred during the winter of 1996/97. Two years of pre-harvest data were collected and one year of post harvest data collection is now complete, with two further years planned. All lakes and streams were sampled for water quality and biota. Sample grids are set up around all lakes, and sampling for small mammals, birds, amphibians and vegetation occurred at these sites. Base camps are set up at each of the three lake study areas to support the over 50 staff and students undertaking the work. Each camp has the capability of supporting 20 to 30 people and provides food, lodging and fuel.

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INTRODUCTION

Large tracts of northern Alberta are now being managed for the harvest of fiber by wood product and pulp and paper companies under Forest Management Agreements (FMAs) with Alberta Environmental Protection. The current operating ground rules call for 30-to 100-m buffer strips to be left around lakes and streams, the width depending on the size and permanence of the water body. However, both government and industry are keen to re-evaluate this ground rule based on detailed scientific information and on the need to take a larger landscape approach to forest sustainability. As a consequence, the Alberta government and six companies: Alberta-Pacific Forest Industries, Weyerhaeuser Canada, Syncrude Canada, Manning Diversified Forest Products, Ainsworth Lumber Co. and CS Resources have entered into a partnership with four universities and the National Hydrology Research Institute (NHRI) to develop a research program designed to examine the role of buffer strips of different widths on aquatic and adjacent upland habitats in the Mixedwood Ecoregion of the Boreal Plains Ecozone.

The TROLS project (Terrestrial and Riparian Organisms, Lakes and Streams), aims to determine the consequences of buffers of different widths on aquatic and terrestrial communities in the Mixedwood Ecoregion of western Canada.

The research focuses around a massive 3-phase experiment:

1. Establish baseline conditions for 2 years for terrestrial, aquatic and hydrological conditions (including fish and wildlife).
2. Clear cut large areas of the study watersheds in an experimental design to leave replicate control areas and areas with buffer strip widths of 0- to 200-m.
3. Monitor changes for 3 years for effects on terrestrial, aquatic and hydrological conditions.

At the time of submission of our Natural Sciences and Engineering Council (NSERC) Collaborative Research and Development (CRD) proposal (December 1996) TROLS had been in progress for over three years, financed by an NSERC CSP grant (awarded July 1994), three forest companies (including MDFP), the government of Alberta and University of Alberta. In 1995 and 1996 TROLS completed logistical organization, protocol adjustment, pre-treatment data collection and establishment of working partnerships with industry and government. It took a full two years to adjust final harvest plans with our industry partners who completed the experimental harvest during the winter of 1996-97.

During the period from July 1997 to March 1998, TROLS successfully completed its first season of post-treatment data collection and is preparing for our second post-treatment sampling season.

OBJECTIVES

In Alberta, we have a unique research opportunity because the forest industry is still in the initial stages of harvesting our northern forests. TROLS will examine how riparian buffer strips of differing widths affect plant and animal communities in riparian and aquatic habitats around lakes and streams in northern Alberta. The main objectives of the TROLS research project are to:

1. Understand the ecological function of riparian forests, especially mature and old mixed-wood forests with a relatively high percentage of aspen trees.
2. Understand the impact of forest harvesting and buffer strips of different width on the ability of riparian forest to conserve plant and animal populations and buffer water bodies from inputs from upland cutblocks.
3. Understand the processes by which terrestrial and aquatic ecosystems are connected.
4. Understand the impact of forest harvesting and buffer strips of different widths on the functioning of lake and stream ecosystems.
5. Provide recommendations on the minimum buffer width required to prevent major changes in aquatic and riparian terrestrial communities as a contribution to sustainable forestry.
6. Train students in an environment where they are exposed to a spectrum of academic discipline and partners focused on resource management in the boreal mixed-wood forest.

PROJECT SCHEDULE

The TROLS Project consists of lake and stream components. The groundwork for TROLS began in 1993, when the 12 experimental lakes were selected from among the thousands of lakes within the Forest Management Areas (FMA's) of Alberta-Pacific Forest Industries and Weyerhaeuser Canada (Slave Lake Division), an area overlapping with the provinces oil sand deposits. In spring 1994, selection of experimental streams was initiated. Pre-harvest (pre-treatment) data collection occurred at the lakes and streams from October 1994 to November 1996. The experimental harvesting around the lakes and streams occurred between November 1996 and March 1997. Post-harvest sampling will continue until late 1999.

STUDY DESIGN AND LOCATION

Lakes Study

The lake study is a block design with groups of four lakes in each of three different regions: Lac La Biche, South Calling Lake, and South Pelican Hills (Figure 1). A base camp is set up in each of the three regions (Figure 1). The experimental units are boreal lakes of uniform size (< 200 ha) surrounded by aspen-dominated forest. In each region, lakes were placed in one of four treatments: reference (no cutting within 800 m of the lake), cutting (following a two pass system) to leave a 20-m riparian buffer strip, cutting to leave a 100-m riparian buffer strip, or cutting to leave a 200-m riparian buffer strip. Thus there are three replicates for each treatment.

Four grids on each lake were set up as part of the core terrestrial sampling design (Figures 2-4). Two harvest and two control grids were laid out on the 20-, 100-, and 200-m lakes. Four control grids were laid out on the 800-m study lakes. Each grid is 400-m long by 100-m wide, with lines running parallel to the lake shoreline every 25-m (Figure 5). The birding studies added extra lines at 125- and 175-m at all the 200-m grids and at half of the 800-m grids. Additional vegetation and small mammal studies were conducted along riparian and upland transects (Figures 2-4). Table 1 lists the grids sampled by various groups.

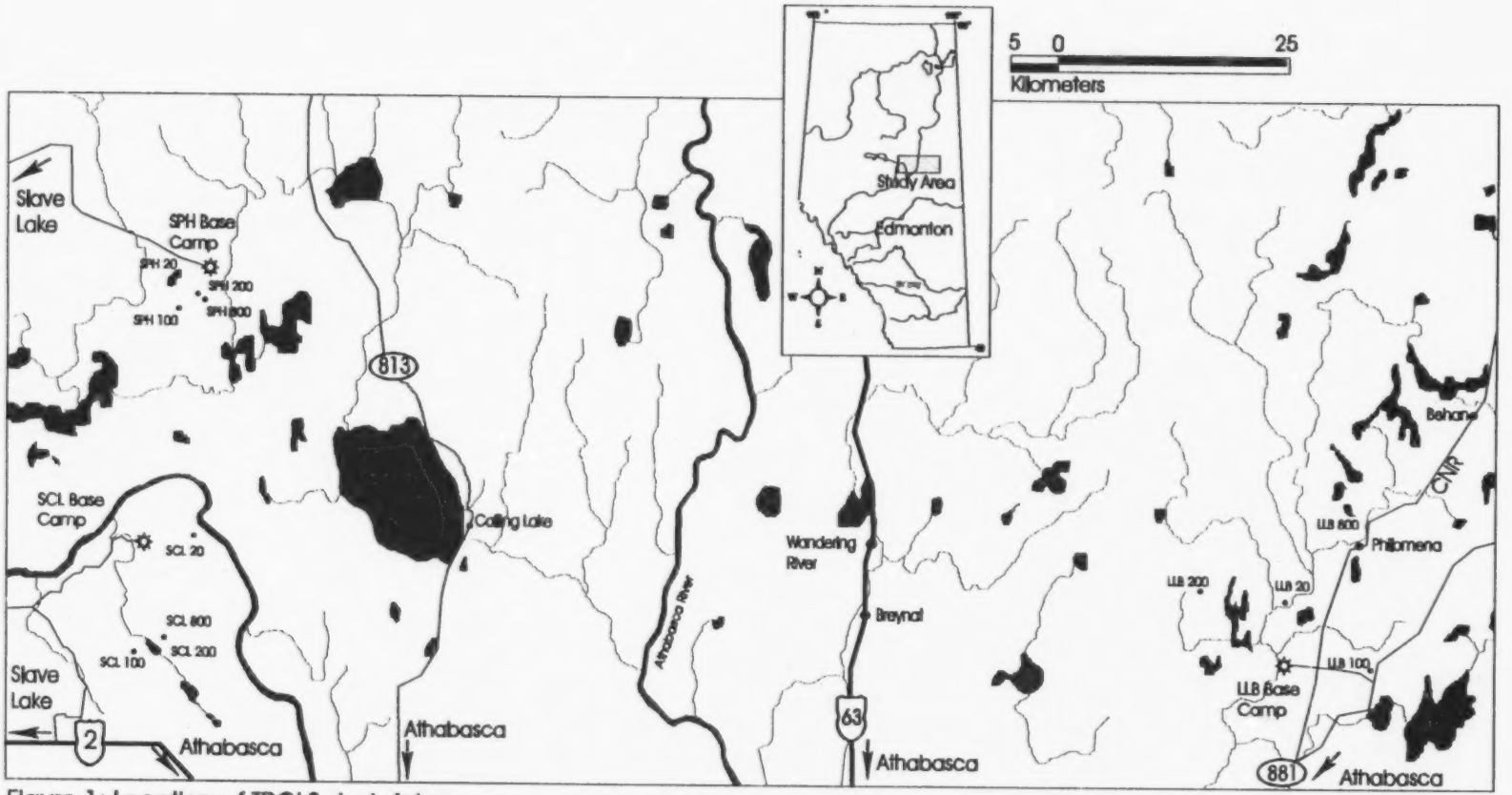

Figure 1: Location of TROLS study lakes.

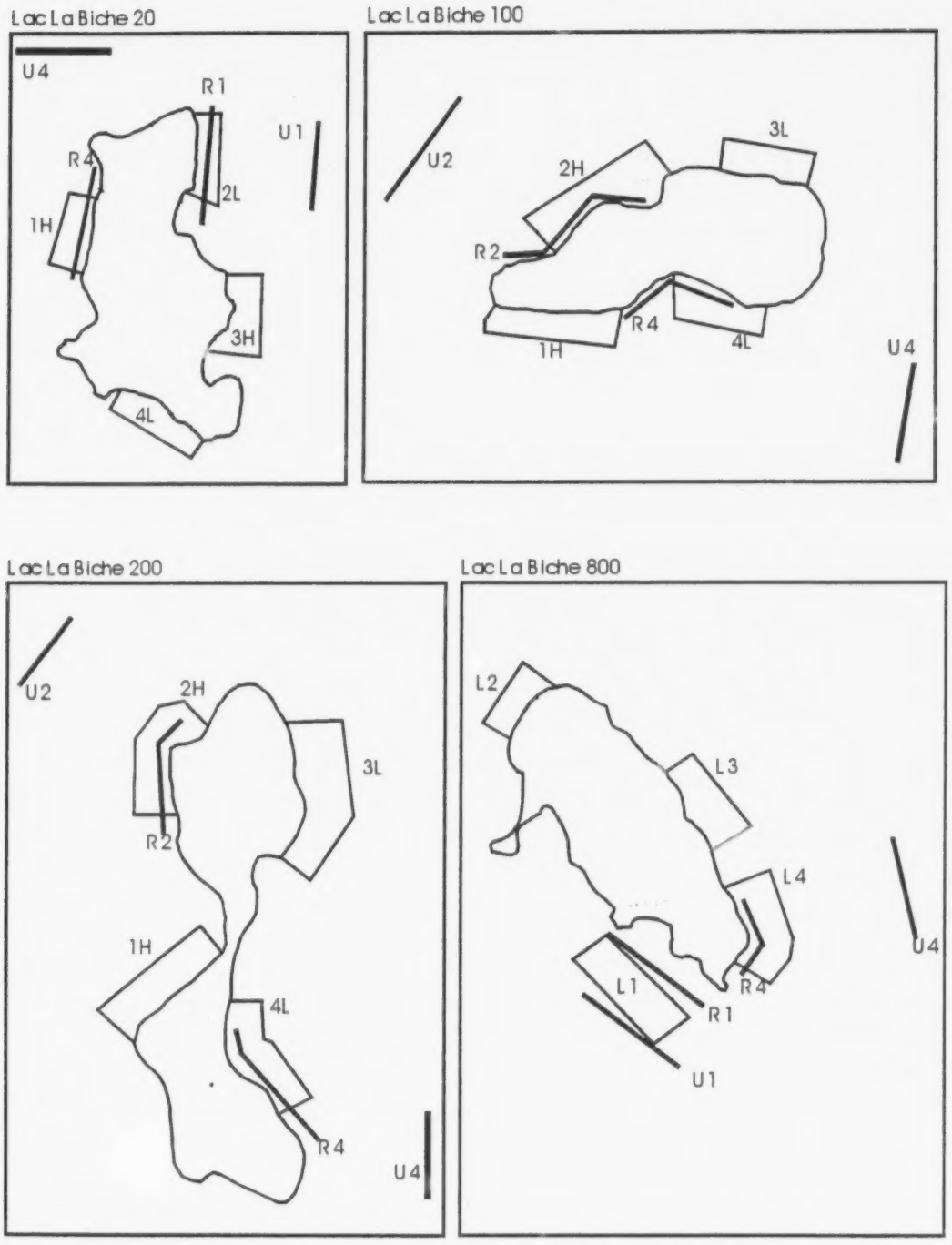

Figure 2: Core terrestrial upland (U) and riparian (R) transects, and harvest (H) and leave (L) grids for the Lac La Biche group of lakes.

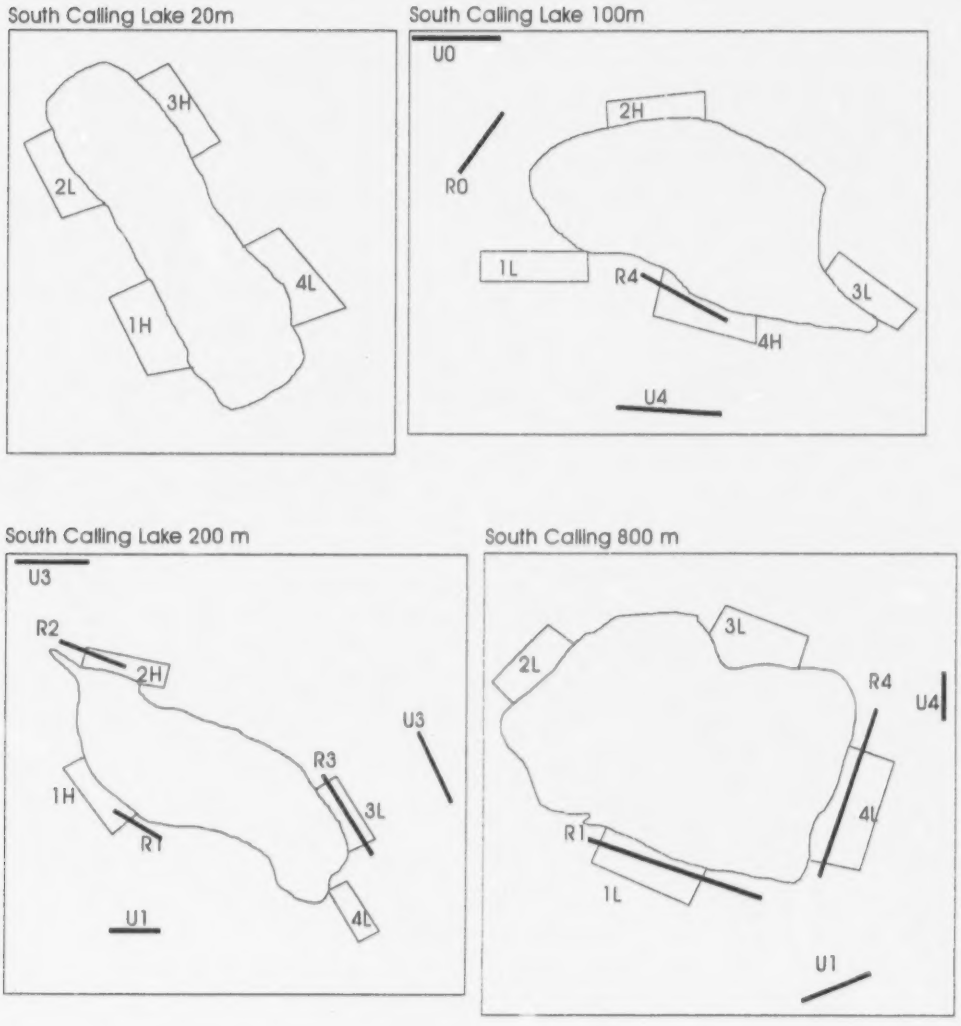

Figure 3: Core terrestrial upland (U) and riparian (R) transects, and harvest (H) and leave (L) grids for the South Calling Lake group of lakes.

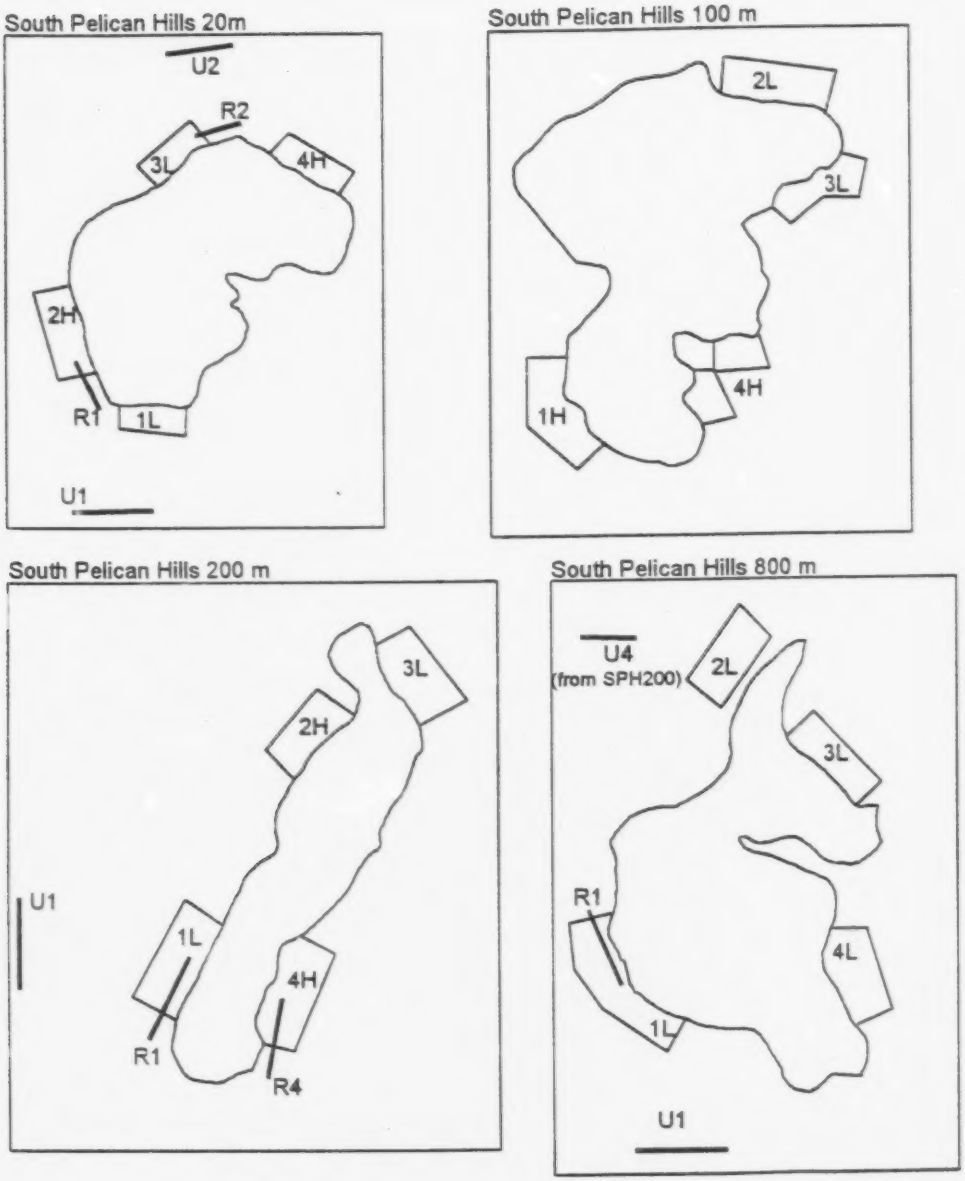

Figure 4: Core terrestrial upland (U) and riparian (R) transects, and harvest (H) and leave (L) grids for the South Pelican Hills group of lakes.

Table 1. Sampling grids used by TROLS terrestrial core programs

	Grids Sampled			
Lake	**Amphibians**	**Vegetation**	**Birds**	**Small Mammals**
LLB 20	1, 2	all	all	1, 2
LLB 100	2, 4	all	all	2, 4
LLB 200	2, 4	all	all	2, 4
LLB 800	1, 4	all	all	1, 4
SCL 20	1, 2	all	all	1, 2 (pre), all (post)
SCL 100	1, 4	all	all	1, 4
SCL 200	2, 3	all	all	2, 3
SCL 800	1, 4	all	all	1, 4
SPH 20	2, 3	all	all	1, 2
SPH 100	1, 2	all	all	1, 2
SPH 200	1, 4	all	all	none
SPH 800	1, 3	all	all	none

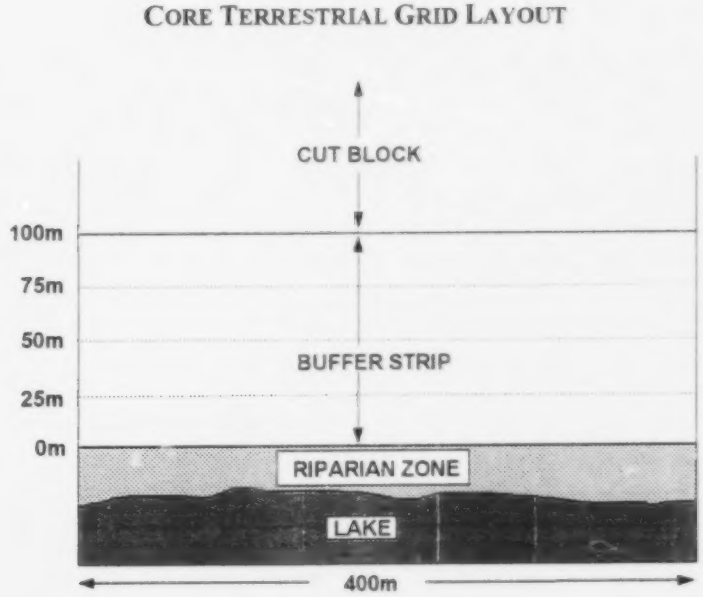

Figure 5: Schematic diagram of the core terrestrial grid layout for a 100-m buffer lake. The grid layout for the 20-m lakes is similar except the boundary between the buffer strip and cutblock is moved to 20 m. For the 200- and 800-m lakes, additional birding lines at 125 m and 175 m are added, and the boundary between the buffer strip and cutblock is moved accordingly. Some of the 800-m grids are lacking a line at 175 m.

Streams Study (Harvest and Fire)

The harvesting stream study is a nested design with five streams southeast of Fort McMurray area (Figure 6). The experimental units are generally third order streams of roughly similar physical characteristics. Each stream has two harvested reaches with approximately 1-3 km of unharvested land in-between The upstream cutblock is harvested to within approximately 30 m of the stream, while the downstream cutblock has little or no buffer. Sampling sites are located immediately above and below each cutblock (Figure 7). There is no permanent base camp; a camper is used to traverse Highway 881.

In 1995, a large fire burned 140 000 ha of forest southwest of Fort McMurray. A study was set up to examine the effects of forest fire on nutrient loading and primary productivity of streams. Several streams were sampled from 1995-1997. The intensity of the burn in the various drainage basins ranged from extreme to no burn.

EXPERIMENTAL HARVEST BLOCKS

The harvesting of the experimental cutblocks occurred between October 1996 and March 1997 (Table 2). This undertaking was achieved after four years of extensive planning with Alberta-Pacific and Weyerhaeuser Canada. The total volume of timber harvested from TROLS experimental cutblocks in Alberta-Pacific's Forest Management Area equaled their entire quota for that year.

The realities of harvesting in remote areas led to some differences between the planned cuts and the final harvest. Most notably, these involved some lower percentage cuts in the SCL region as well as some variable width buffer strips, particularly at the SCL20 study lake. Variable buffer width is a common problem when working with heavy machinery along a lake shore, as the terrain often impedes the ability to remove trees in some areas. Alberta-Pacific returned to this area during the winter of 1997/98 to complete the harvest.

Variable buffer widths were also encountered in the streams areas where, again, it was not always possible for the harvest machinery to access the trees in difficult terrain. Hand falling of trees is certainly a consideration to overcome this problem, but is not a process that is carried out by Alberta-Pacific. This is a problem that future studies must consider and should be prepared to do, when and if the study design calls for complete removal of all trees.

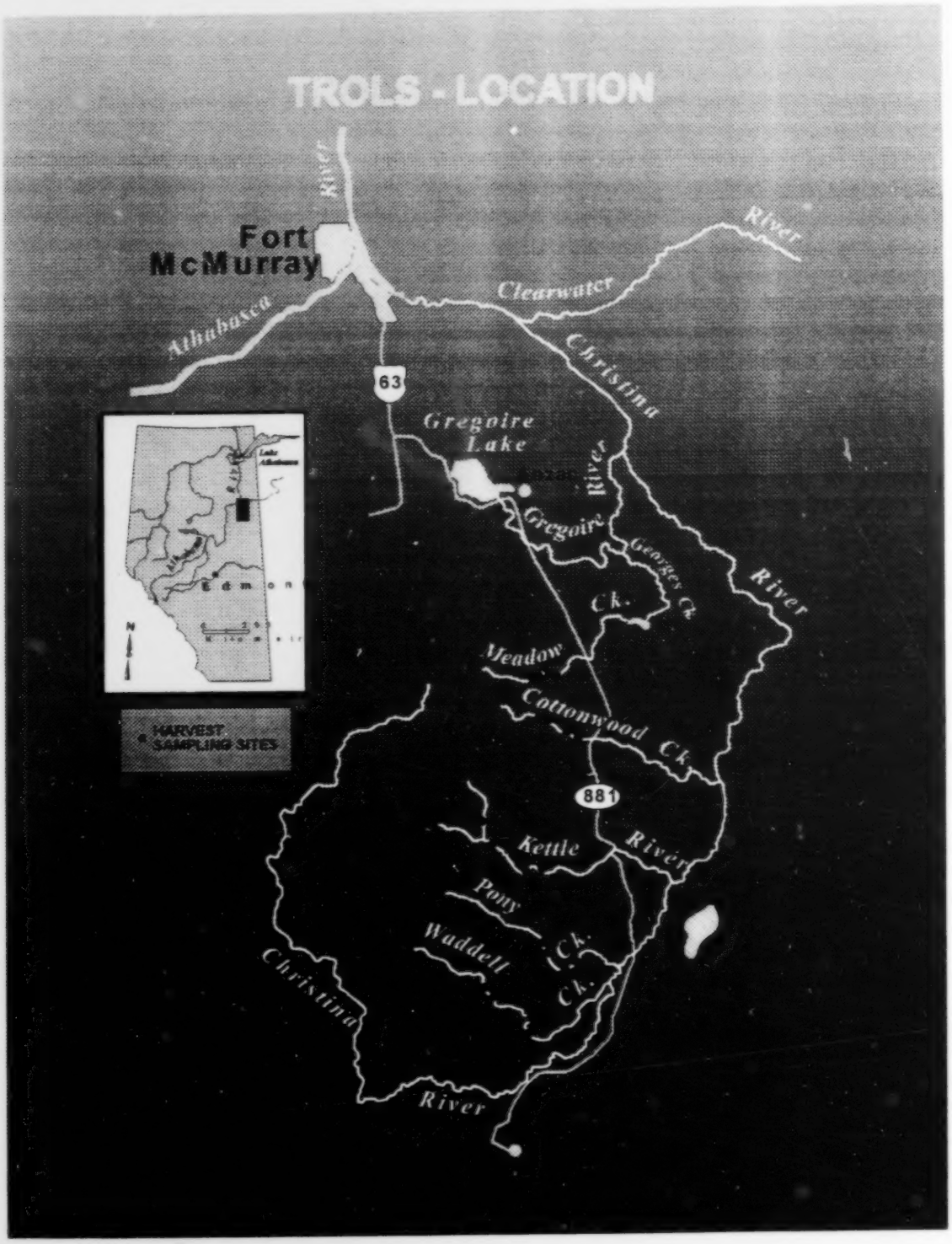

Figure 6. Location of TROLS harvest Study Streams

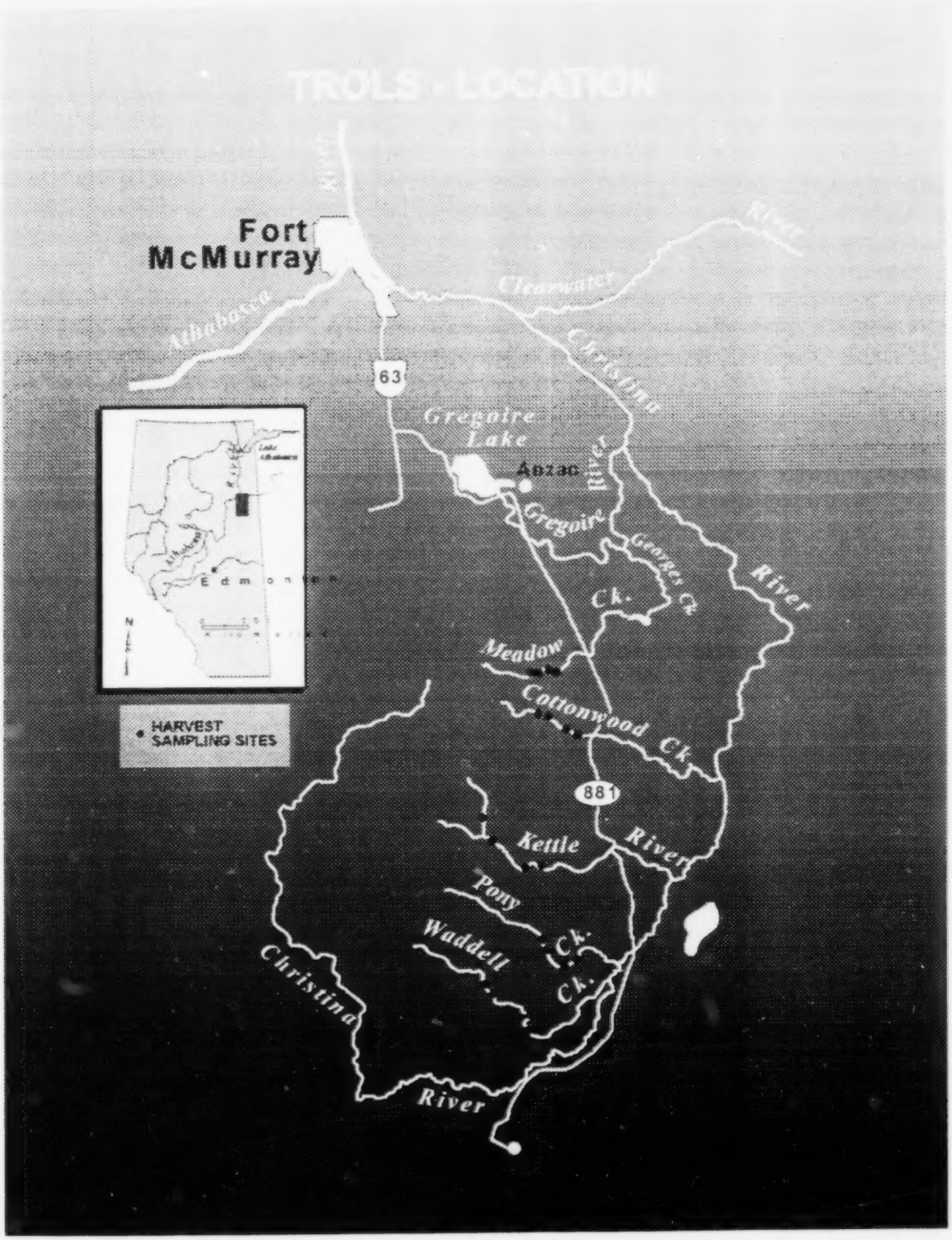

Figure 6. Location of TROLS harvest Study Streams

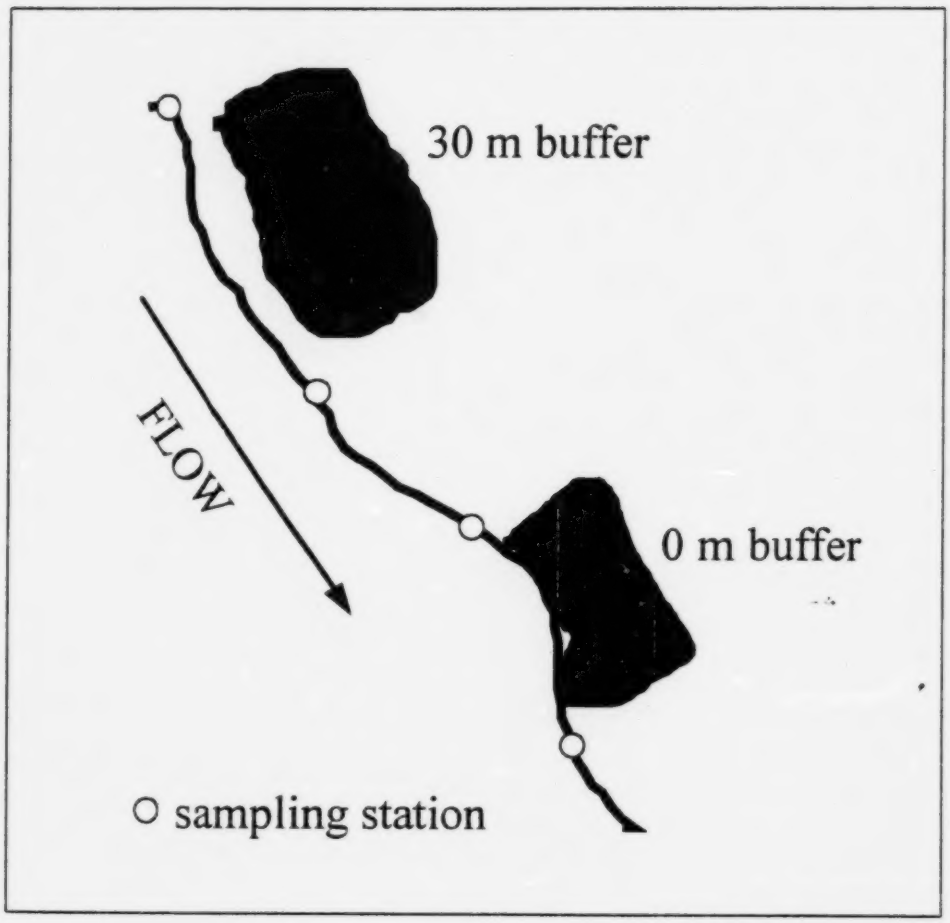

Figure 7. Schematic diagram of harvest stream instrumentation and sampling sites

Table 2: Date of Harvest and Amount Harvested within the 800m study zone and within the drainage basin of each lake

	Date of first harvest in drainage area	Date of harvest within 800 m study zone	Total area cut within 800 m study zone (ha)	Total area cut within lake drainage area (ha)	Total area cut within drainage area within 800m of lake (ha)	% of drainage basin harvested prior to summer 1997	% Cut within 800 m study zone prior to summer 1997	% Cut within drainage area that is within 800m prior to summer 1997
SCL20	winter 1996-97	winter 1996-97	31.2	22.9	8.3	3.6	6.8	3.8
SCL100	winter 1996-97	winter 1996-97	37.7	30.9	30.9	11.7	10.8	16.4
SCL200	winter 1996-97	winter 1996-97	85.9	670.2	79.4	9.9	13.9	15.6
SCL800	no harvesting	no harvesting	0.0	0.0	0.0	0	0	0
LLB20	summer 1995	winter 1996-97	102.0	149.4	91.2	26	21.8	34.6
LLB100	winter 1996-97	winter 1996-97	76.8	40.6	40.6	38.4	20.1	38.4
LLB200	winter 1996-97	winter 1996-97	60.8	22.9	22.9	12.1	13.5	12.1
LLB800	winter 1993-94	winter 1993-94	20.1	50.7	20.1	10.7	3.5	5.2
SPH20	winter 1996-97	winter 1996-97	246.2	301.8	156.8	30.1	39.5	35.3
SPH100	winter 1996-97	winter 1996-97	110.9	104.0	30.8	14.8	24.3	11.5
SPH200	winter 1996-97	winter 1996-97	79.4	169.9	51.1	17.8	16.1	15.3
SPH800	winter 1996-97	no harvesting	0.0	31.2	0.0	4.6	0	0

Note: In late summer 1995, 6.9% of LLB20's drainage basin was harvested (no harvesting occurred within 800-m of lake)

PRINCIPAL INVESTIGATORS

TROLS consists of a team of twelve principal investigators (from four institutions) each with expertise in one or more areas of biology/forest science/hydrology:

Dr. E.E. Prepas, Director	Department of Biological Sciences, University of Alberta
Dr. S.E. Macdonald, Co-Director	Department of Renewable Resources, University of Alberta
Dr. S.A. Boutin	Department of Biological Sciences, University of Alberta
Dr. P.A. Chambers	National Hydrology Research Institute
I.F. Creed (degree pending)	Department of Geography, University of Victoria
Dr. J.M. Culp	National Hydrology Research Institute
Dr. S.J. Hannon	Department of Biological Sciences, University of Alberta
Dr. C.A. Paszkowski	Department of Biological Sciences, University of Alberta
Dr. B.A. Pinel-Alloul	Département de Sciences Biologiques, Université de Montréal
Dr. R.L. Rothwell	Department of Renewable Resources, University of Alberta
Dr. W.M. Tonn	Department of Biological Sciences, University of Alberta
Dr. F.J. Wrona	National Hydrology Research Institute

In addition to the above Principal Investigators, Dr. K. Devito was invited to work with I.F. Creed to assist with implementation of the hydrology component.

CORE PERSONNEL AND ASSISTANTS

Management of TROLS' extensive Core sampling program, data entry, base camp operations, logistics and maintenance is accomplished by a team of four full-time personnel:

Andrew McAllister	Terrestrial Coordinator
Sharon Reedyk	Aquatic Coordinator
Mark Serediak	Project Administrator
Warren Zyla	Logistics Coordinator

In addition, the project's core program employed 20 summer and winter field/research assistants to carry out sampling, lab analysis and data entry. A further 12 summer assistants were employed to assist with graduate student studies.

BASE CAMPS AND SITE ACCESS

The three lake study area base camps (Figure 1) have been in operation since the spring of 1995. They are located in remote areas and are separated by great distances; the average travel time between camps is 3 hours. These camps are used as the base of operation for all personnel accessing the TROLS lakes. Two camps (SCL and LLB) are equipped with a large cook/lab tent, storage sheds, generator, outhouse and solar powered electric bear fence. Every individual is provided with a personal tent which they set up within the confines of the camp. The SPH camp consists of a medium-sized lab/sleeping trailer, provided by the Dept. of Renewable Resources, U of A, and a large cook/lodging trailer provided by Alberta Environmental Protection (AEP). A generator and outhouse are also provided by AEP. A number of small mobile remote camps are also used by personnel who require quick access to study sites.

The streams camp consists of a truck mounted camper unit which was purchased by the project. This method better facilitates the needs of the streams personnel to access the stream sites, which are located over a very large area (Figure 6). When large crews are in the area, a second camper is provided by the National Hydrology Research Institute (NHRI).

Access from the camps to the study sites is accomplished on all terrain vehicles (ATV's) using a network of over 200 km of trails and cutlines. These trails require constant upkeep by the field personnel. In the spring of 1997, all students and assistants were pulled off their projects for approximately 5 man/days each to perform trail repairs and maintenance. I addition, a trail crew was hired to perform necessary repairs and build bridges. A full time trail crew will be hired for the 1998 summer field season. Recent wet weather has caused many problems with access to sites. A higher than normal level of trail maintenance work was required in 1997. Difficulties with access often translates into higher maintenance costs of our fleet of 24 ATV's, four 4x4 trucks, and 13 trailers.

Access onto and across lakes is accomplished by the use of a fleet of over 16 small aluminum boats and/or canoes. Again, further boats, which were to be purchased in 1997, will be in place at the more active sites in 1998 to lessen the demand for access from the various research programs.

SCIENTIFIC PROGRESS

Core Terrestrial Program- Amphibian Section
Principal Investigator: Dr. C. Paszkowski

General Objectives and/or Hypotheses

Hypothesis 1: Due to penetration of edge effects and reduced area of riparian forest habitat, reducing the width of the riparian forest strip will compromise its ability, and the ability of the riparian zone, to conserve amphibians.

Predictions 1:

- Warmer air temperatures and increased productivity of understory vegetation in bufferstrips will benefit terrestrial amphibians by: i) increasing the temporal window for activity and feeding on a daily and annual basis; and ii) creating a more heterogeneous, more structured forest -floor habitat.
- Drier conditions in buffer strips will reduce the duration and location of activity of amphibians and may counter positive temperature effects.

Hypothesis 2: Harvesting will alter patterns of movement of amphibians on the landscape by creating new breeding habitat but by reducing the quality of upland foraging and hibernation sites and/or making access to these sites more difficult.

Predictions 2:

- Amphibian breeding habitat will improve following harvesting, because of higher water table and increased input of nutrients and light into shallow water environments, resulting in increased production of young-of-the year.
- Amphibian movements in a harvested landscape will differ from those in an unharvested landscape because the creation of riparian buffer strips and clearcuts will change the distribution and quality of breeding, foraging and hibernation sites and influence the animals' access to these sites.

Sampling Location and Variables Sampled

Pitfall Trapping

Pitfall arrays are used to monitor amphibian diversity, abundance, condition, and distribution at each of the 12 TROLS study lakes. Pitfall arrays consist of 3 pitfall traps (buried metal cans 15 cm wide and 25 cm deep) connected by drift fence (15 cm high and 5 m long polyethylene), to form an open triangle with the open side facing the lake. There are three transects containing 5 pitfall arrays, 40 m apart (45 traps in total), within 1 harvest and 1 reference grid on the 20-, 100- and

200-m lakes and within the 2 reference grids on the 800-m lakes (refer to Table 2 for specific grid numbers). Transects are located in the unforested riparian zone (0 m), 50 m inland from the riparian/forest interface, and 100 m inland (Figure 5). Two sampling sessions, one in the spring and early summer during the breeding period and one in late summer to monitor newly metamorphosed young-of-the-year, are conducted on each lake. Sessions last 5 to 8 days with the traps checked every 48 hours. Individuals caught are identified to species and counted in order to estimate abundance and distribution. Snout-vent length and weight of individuals is recorded in order to catalogue the health and condition of each animal. Each individual is also toe clipped for mark-recapture estimates and to identify the location of first capture (grid and transect). Toes are preserved for use in aging based on growth rings in the phalangeal bones.

Visual Searches

Trapping is supplemented by additional, auxiliary visual searches, which also generates data relevant to both hypotheses. In 1995 and 1996, searches were conducted along transects in the terrestrial sampling grids to determine if pitfall trapping was biased in terms of species or size classes. The procedure involved covering a set route over a set amount of time, while carefully examining the ground, under structures, etc. When an amphibian was encountered, the "clock" was stopped and the location was recorded. The animals were measured (as mention for trapped individuals) and released, and then the timing was resumed. In 1997, visual searches were modified to document amphibian use of ponds or wet areas in forest and cutblocks in the South Pelican Hills and South Calling Lake study areas. These data are especially relevant to Hypothesis 2.

Progress to Date

Pitfall Trapping

In 1995, a total of 1080 pitfall traps across the 12 lakes were installed and 6 days of late summer trapping was conducted at each of the lakes at South Calling Lake and Lac La Biche. In 1996, spring and late summer trapping sessions were conducted at South Calling and Lac La Biche and a late summer session was conducted at South Pelican Hills. In 1997, spring and late summer trapping sessions were conducted at all the study lakes. Data collected in 1995 and 1996 has been entered on spreadsheets. Data collected in 1997 has been summarized but has yet to be entered. Four species of amphibians were encountered: Boreal Chorus Frog (*Pseudacris triseriata maculata*), Wood Frog (*Rana sylvatica*), Western or Boreal Toad (*Bufo boreas boreas*), and Canada or Dakota Toad (*Bufo hemiphrys*). The first three species were captured in all three areas, the Canada Toad only at Lac La Biche. Over 200 amphibians in 1995, 1500 in 1996, and 700 in 1997, were captured, measured, and toe clipped.

Visual Searches

Visual surveys were conducted in 1995, 1996 and 1997. In 1997, visual surveys were conducted at ponds or wet areas in 10 cutblocks and 10 forested areas at South Pelican Hills and at 2 cutblocks and 2 forested areas at South Calling Lake.

Projected Work

The 1997 core data will be entered in the winter of 1998. Core monitoring (pitfalls and visual searches) will be continued in spring and summer of 1998. Results of two years of preharvest sampling and two years of post harvest sampling will be analyzed.

Core Terrestrial Program - Bird Section
Principal Investigator: Dr. S. Hannon

General Objectives and/or Hypotheses

Hypothesis - Due to penetration of edge effects and reduced area of riparian forest habitat, reducing the width of the riparian forest strip will compromise its ability, and the ability of the riparian zone, to conserve wildlife.

A - Spot Mapping Data

Repeated censusing of grids will allow the delineation of bird territories through clusters of species registrations.

Sampling Locations / Progress to Date

Spot mapping is being conducted along transects at the forest edge (all grids) and those parallel to the forest edge at 25- and 75-m (all grids except 20 m harvest grids), 125-m (200- and 800 m grids), and 175-m (200-m grids and 50% of 800-m grids) into the forest. Spot mapping reference points are located 50 m apart along these transect lines. Please refer to Table 2 and Figures 2 to 4 for locations of sampling grids. In 1995, all grids at SCL and LLB were sampled. In 1996, all grids except for the 20m lakes, were sampled. All terrestrial grids at all lakes were sampled for birds in 1997. Spot mapping takes place from the end of May until the beginning of July. In 1995, grids were surveyed on 8 occasions. In 1996 and 1997, grids were surveyed 6 times.

Variables determined from spot-mapping data for each grid

Species richness
Number of territories per species
Evidence of breeding (i.e. nests, nest material, food, fledglings)

Projected Work

I will continue data analysis of immediate post-harvest responses by birds by correcting for local vegetation composition (see next subsection) and assessing the contribution of landscape forest cover in the 800-m strip around the lake on responses of birds to the buffer strip width. In 1998, 20-m buffers and nested controls will be resampled at SCL due to incorrect buffer width in 1997. Spot mapping will be conducted at all lakes during the 1999 field season.

In order to address the question of *Buffer strips as preferred habitat and movement corridors for winter resident birds*; a Ph.D. student will commence work on this project starting in the late fall of 1998 for three winters.- At each lake we will lay out 8 transects: one in each cut buffer strip and one in each adjacent cutblock plus one in each uncut buffer strip and one in each adjacent block of uncut upland forest. By pairing the transects we can test whether birds are encountered more often in riparian forest and if so, whether this is because it is preferred habitat in winter (more encounters in both cut and uncut buffers compared to upland transects) or whether they are using the buffer strips to move across the landscape (more encounters in cut buffers only). Each transect will be 400m long, will parallel the lake shore and will sample a width of 100m of habitat. The upland transect would be positioned 200m from the harvested edge (cutblocks cannot be larger than 400m wide) or the equivalent distance from the shore in the case of unharvested blocks. Each transect will be surveyed 5 times between mid November and mid March under conditions of low wind and the positions of all birds heard or seen will be mapped. Positions of all retained groups of trees (potential stepping stones) in the cutblocks will be mapped.

Surveys will be supplemented by doing gap crossing experiments using playbacks of the chickadee mobbing call to test the propensity of different species to cross gaps of different widths and gaps with and without "stepping stones" present. Controls are done across similar distances in intact forest.

B - Vegetation Sampling

Vegetation sampling being done on the bird sampling grids will allow us to account for effects of local variation in vegetation in the buffer strips on bird community composition and density and allow us to isolate treatment effects.

Sampling Locations / Progress to Date

Vegetation sampling is being conducted every 50 m along the transects at the forest edge (all grids) and those parallel to the forest edge at 25- and 75-m (all grids except 20 m harvest grids), 125-m (200- and 800 m grids), and 175-m (200-m grids and 50% of 800-m grids) into the forest (i.e. each sampling point in the spotmapping grid). The vegetation sampling plots are set up just off the transect to avoid effects of trampling. In 1996, all harvest grids were sampled. In 1997, all remaining leave grids were sampled. Vegetation sampling takes place from the beginning of July until the middle of August.

Variables Sampled

Within a 5 x 20 m plot (lengthwise to transect):
tree density (by species)
size (diameter at breast height - dbh) for every tree
average canopy height
canopy cover
snag density
height and condition (by species) of snags

litter depth
slope

In a 10 m^2 circular plot within the tree plot:
shrub % cover
height, and density (number of stems) by species of shrub
herbs+dwarf shrubs % cover
grass % cover
lichens+bryophytes % cover
litter %cover
bare ground % cover
woody material % cover

In addition general characteristics of the forest structure are being mapped for the entire spotmapping grid including: gaps, pockets of conifer or willow, marshy areas, groups of snags, etc.

Projected Work

Vegetation sampling will be repeated on all harvest grids during the 1999 field season following the same protocol.

C - Productivity Surveys

Though spot mapping allows us to delineate bird territories, it does not provide much information concerning breeding success. Productivity surveys using chickadee mobbing calls will allow us to evaluate breeding success for certain focal species.

Sampling Locations / Progress to Date

Productivity surveys took place at all harvest grids and half of the grids on the control (800 m) lakes during the 1997 field season. Territories (determined by spot mapping) for each focal species were surveyed on three occasions for breeding success using the productivity protocol.

Variables Sampled (for each focal species)

presence/absence
sex
response (i.e. chipping, presence of food, nest material, fledglings)
other species' responses
Projected Work

I will evaluate the 1997 data to see if it provides a clearer picture as to the breeding success of certain focal species. This will determine whether or not to continue with these surveys in 1999 when the spot mapping resumes at all lakes.

Core Terrestrial Program - Vegetation section
Principal Investigator: Dr. S.E. Macdonald

General Objectives and/or Hypotheses

One of the underlying assumptions of the importance of buffer strips around water bodies in terms of benefits to terrestrial ecosystems is that riparian forests are unique in terms of their ecological structure and/or function and that, therefore, the associated wildlife communities are particularly diverse and or host unique. This study was, therefore, a fundamental first step in the TROLS project. Our objective was to assess the ecological uniqueness of riparian forests in terms of structure, composition, and ecological function, through comparison of riparian forests with similarly-forested areas which are away from water bodies.

Sampling Locations and Variables Sampled

Twenty stands were examined at ten lakes during the summers of 1995 and 1996 (Figures 2-4). Sampling was conducted at: LLB-20, LLB-100, LLB-200, LLB-800, SCL-100, SCL-200, SCL-800, SPH-20, SPH-200, SPH-800. Criteria for stand selection included: 1) stands that adjoined TROLS lakes and continued at least 800m upland away from the lakes; 2) tree species composition that was aspen dominated; and, 3) reasonably good access. All selected stands were pure deciduous in composition and initiated from fires occurring between 1900 and 1930.

In 1995, both riparian and upland forests were sampled using 400m transects with 10 systematically placed, nested quadrats. Based on preliminary data analysis the sampling regime was changed in 1996 to 100m transects with five systematically placed, nested quadrats. The transects were located 50m (riparian) and between 600 and 800m (upland) from and parallel to the riparian forest edge. Each transect was considered to be an experimental unit. Sampling of understory and overstory vegetation was carried out using nested, fixed-area plots and point quarter sampling. The line intercept method was used for determination of downed coarse woody material, categorised by decay class as follows: 1) whole log, undecayed bark, branches and twigs present and intact, wood hard; 2) log sound, wood hard, twigs mostly lacking, greater than 50% bark remaining; 3) some branches remain, less than 50% bark remaining, soft spots in wood; 4) little to no bark, no branches, fungi present, wood soft and small pieces missing, bryophyte colonization near ground; 5) large wood fragments missing, outline deformed, partially to mostly moss-covered, vascular plants colonizing; 6) Wood mostly well decayed, completely moss-covered and colonized by vascular plants; and 7) humification nearly 100%, hard to define as a log, outline indeterminable, no hard wood. All vegetation data were collected during the months of July and August.

The following parameters were assessed at each sampling point along each transect: Percent cover (by cover class) for shrubs and herbs to species; percent cover for mosses, lichens and litter; Litter depth; average height for each shrub species; tree stem density by species; snag density; snag percent bark, height and extent of top breakage; overstory canopy cover; basal area by tree species; height, diameter (at breast height) and age of dominant canopy trees by species; percent

cover of downed coarse woody material by decay class and species (if possible); extent of browsing; relative nutrient availability (using ion exchange resin bags).

Transect means were calculated for use in subsequent analyses. Average percent cover, diversity and richness of herbs and shrubs, as well as total tree density, basal area were calculated for each transect. Additionally, transect variances were used to give an estimation of local heterogeneity for some parameters (canopy cover, tree height, basal area).

Core Terrestrial Program - Small Mammal Section
Principal Investigator: Dr. S. Boutin

General Objectives and/or Hypotheses

Hypothesis 1: Riparian forest is unique, as compared to upland forest, in terms of its species composition and ecological function because of its topographic position, the water-land interface and a lower frequency of fire disturbance.

Hypothesis 2: Due to penetration of edge effects and reduced area of riparian forest habitat, reducing the width of the riparian forest strip will compromise its ability, and the ability of the riparian zone, to conserve small mammals.

Sampling Locations

Hypothesis 1: Small mammal abundance is recorded in riparian and upland forest around lakes using paired transects: one transect parallel to the lake shore and 50m into the forest from the riparian forest edge, and a similar transect between 600-800m away from the lake shore but in the same stand of forest. Each transect is 400m in length..

Hypothesis 2: Small mammal censuses are done in duplicate (one 'buffer' and one 'control' grid per lake) at each of the lakes at Lac la Biche and South Calling Lake. Transect lines are 400m long and placed parallel to the lake shore in the riparian zone and along the transects 50 and 100m into the forest. South Pelican Hills was not monitored prior to harvesting due to costs but SPH 20 and SPH 100 being monitored post-harvest.

Variables Sampled

Each transect has 30 Longworth live-traps and is set for 3 consecutive nights in spring and fall. Species, weight, sex, reproductive status and age (adult or juvenile) are recorded for all individuals captured.

Vegetation sampling is also conducted on the small mammal sampling grids. This will allow us to account for effects of local variation in vegetation in the buffer strips on small mammal community composition and abundance and allow us to isolate treatment effects. The sampling is being conducted every 50 m along the transects at the forest edge and those parallel to the forest edge at 50 and 100 m into the forest. The vegetation sampling plots are set up just off the transect

to avoid effects of trampling. Please refer to Table 2 and Figures 2 to 4 for locations of sampling grids.

Variables Sampled (within 10 m^2 circular plot):

- % cover of shrubs and average height (to species)

Variables Samples (within 1 m^2 square plot):

- % cover dwarf shrubs and herbs (to species)
- % cover lichen
- % cover bryophytes
- % cover litter
- % cover bare ground
- fruit or seed production for shrubs, dwarf shrubs, herbs and grasses

Downed Coarse Woody Debris (DWM) Variables sampled along 25m sections of transect:

- size (dbh)
- decay class
- species

Progress to Date

Spring and fall censuses completed twice prior to harvesting (May & August 1995, May & September 1996) and once post-harvest (May and September 1997). Data entry and verification completed and preliminary analyses commenced. In 1996, vegetation sampling occurred on all harvest grids. In 1997, all remaining leave grids were sampled for vegetation. Vegetation sampling takes place during July.

Projected Work

Spring and fall census in 1998 (second year post-harvest) to continue monitoring changes in species composition and abundance following harvesting. There are no anticipated changes to the sampling design at this time.

Core Terrestrial Program - Seen Sheets

General Objectives

Many species operate at a scale larger than that of a typical terrestrial grid. Seen sheets provide an inexpensive measure of the encounter rates for these species which can then be used to estimate population sizes and larger scale treatment effects.

Sampling Locations / Progress to Date

Seen sheet study zones were established in an 800-m radius around each study lake in 1995. Data have been collected within these zones for 1995, 1996 and 1997.

Variables Sampled (for each lake)

time spent in the field
number of individuals/species observed

Future Work

The collection of seen sheet data will continue following the same sampling protocol for the 1998 and 1999 field seasons.

Core Hydrology Program
Principal Investigators: I Creed, K. Devito and R. Rothwell (with Dr. K. Devito)

General Objectives and/or Hypotheses

The general hypothesis of the hydrology program is that the export of nutrients from terrestrial to aquatic ecosystems is regulated by the land's subsurface, saturated flow pathways and their intersection with the land's surface mosaic of differential nutrient availability. The main objectives of the program are twofold. Firstly, at a local scale, to explain upland-lake hydrological linkages and from that understanding, determine the impacts of harvesting upland areas on nutrient loading to the lake. Secondly, at a regional scale, to examine groundwater-lake interactions to develop an index of lake susceptibility to increased nutrient loading from harvesting within its catchment area.

Variables Sampled

Primary Data

Water Chemistry (summer 1997) - Lake inlets and outlets (surface water), LLB20 sub-catchment (surface- and ground-water): total and total dissolved phosphorus, nitrate, ammonium, total dissolved nitrogen, dominant cations and anions, dissolved organic and inorganic carbon, pH, conductivity; *LLB20 sub-catchment (lysimeters)*: total and total dissolved phosphorus, nitrate, dissolved organic and inorganic carbon
Physical Variables (summer 1997) - LLB20 sub-catchment: surface- and ground-water temperature, water table depth, piezometric head, lithology, hydraulic conductivity, snow depth and snow water equivalencies (winter 96). *Lakes:* lake water levels, spot discharge measurements of some inlets and outlets of LLB20, LLB800, SPH20, snow depth and snow water equivalencies (winter 95-96).

Meteorological Variables (1995-1997): mean daily incoming solar radiation, wind speed, relative humidity, air temperature, and total daily precipitation

Secondary Data

- hydrogeological cross-sections
- lithology
- climate patterns
- lake water budgets

Sampling Locations

Our local-scale hill slope studies are focused at LLB20. We have instrumented a sub-catchment of the lake, located in the northeast corner, which consists of three draws: A - uncut, B - cut, C - cut which converge into D and drain to the lake. The sub-catchment is instrumented with piezometers, wells, and lysimeters.

Continuous water level recorders were installed on the 20- and 800-m study lakes. Meteorological equipment was installed only at the 20-m study lakes. Water chemistry samples and spot discharge measurements were made at some inlets and outlets of some lakes.

Snow surveys were completed at one or two transects at the 20- and 800-m study lakes. A more detailed snow survey was completed at the LLB20 sub-catchment.

Progress to Date

The hill slope studies at LLB20 began in the summer of 1996; however, instrumentation of the sub-watershed continued through summer 1997. In summer 1997 surface- and ground-water samples were collected from throughout the sub-watershed. The piezometers/wells were sampled weekly, as installed, for pH, conductivity, temperature, piezometric head and groundwater depth. Monthly water samples were taken of other chemical parameters. Surface runoff was sampled periodically throughout the summer. Two deep piezometers (up to 9 m) were installed to assess deeper groundwater flow paths.

Water budgets have been estimated for all study lakes from regional precipitation, evapotranspiration, and unit-area runoff estimates. The runoff estimates were derived from 2-3 large order streams. Precipitation estimates were derived with measurements from 4 regional weather stations and weighted according to distance to lake. Evapotranspiration was estimated with Thornthwaite's equation.
We have completed 2-dimensional cross-sections of the basic hydrogeology of the 3 sets of lakes. Geochemical analyses of the lakes, regional and local groundwater have been started but are not complete. A few deep piezometers have been installed at LLB20 and SPH20.

Projected Work

We will continue our field sampling program in summer 1998. We will install additional deep piezometers at a few lakes and continue our surface- and ground-water sampling at the sub-catchment and the lake inlets and outlets.

We will begin some basic groundwater modeling at a regional scale and try to generate a predictive model of nutrient export at a local scale.

Core Aquatic Program - Limnology Section
Principal Investigators: Drs. E.E. Prepas an B. Pinel-Alloul

General Objectives and/or Hypotheses

The limnological data in conjunction with hydrological data will be used to assess the impact of harvesting on inputs of nutrients, sediment and particulate organic matter to the lakes. The data will be used to assess effectiveness of buffers, as well as the susceptibility of lakes to increases in nutrient (particularly phosphorus and nitrogen) loading from disturbance in the drainage basin. We will test the following hypotheses:

Hypothesis 1 Riparian forest surrounding a lake is intimately involved in lake ecosystem processes by affecting allochthonous inputs of water, nutrients, sediments and particulate organic matter to the lake.

Hypothesis 2 Changes in water, nutrient, POM, and sediment loads due to harvesting in riparian forest will affect biomass and species composition of primary producers and, via "bottom-up" processes, alter the distribution and abundance of higher trophic levels in the lake's food web

Hypothesis 3 Changes in the rates of primary production and external carbon inputs will affect decomposition and winter oxygen depletion rates.

Variables Sampled

Water Chemistry: total chlorophyll a, chlorophyll a < 20 um, total phosphorus, total dissolved phosphorus, NO_3+NO_2, NH_4^+, total dissolved nitrogen, particulate nitrogen, dissolved inorganic carbon, dissolved organic carbon, particulate carbon, Ca, Mg, Na, K, SO_4, Cl, field pH, lab pH, conductivity, alkalinity, CO_3, HCO_3, dissolved oxygen, soluble reactive phosphorus (1997)

Physical Variables: water temperature, light (PAR), Secchi disk depth, bottom depth

Sediment traps: organic and inorganic fractions of sediment (g/m^2)

Biological Variables: phytoplankton,(# species, size distribution, biomass), zooplankton (# species, size distribution, biomass) macrophytes (dry weight of each submerged species (g/m^2))

Leaf Litter: dry weight (g/m^2)

Sampling Locations

Water Chemistry: An integrated sample of the euphotic zone was taken from three points in a lake and pooled. An integrated epilimnion sample was taken at the deepest point in each lake. A discrete sample from the middle of the hypolimnion was taken in the deeper lakes. In 1997 some inflows and outflows of the 20- and 800-m lakes were sampled.

Phytoplankton: An integrated sample of the euphotic zone was taken from three points in a lake and pooled. An integrated epilimnion sample was taken at the deepest point in each lake.

Zooplankton: One vertical haul was taken from one metre above the sediments to the surface at each of the three points where the euphotic sample was taken.

Sedimentation: Sediment traps were placed in LLB20 in 1996 and 1997. Additional traps were placed in the epilimnion and hypolimnion of SCL20, SCL100, LLB100, LLB800, SPH20 and SPH200 in 1997.

Macrophytes: Macrophytes were sampled from four transects in LLB20 and from six transects in LLB800 in 1996 and 1997.

Leaf Litter: Leaf litter traps were placed along four (1996) to six (1997) transects in LLB20.

Progress to Date

Water Chemistry, Phytoplankton, Zooplankton

In 1995 the 12 study lakes were sampled 6 (SPH and SCL) or 7 (LLB) times from May to September and 4 times (no zooplankton samples) over the 1995-96 winter. In 1996 the 12 lakes were sampled 7 times from May to September and 4 times (no zooplankton samples) over the 1996-97 winter. In addition, we initiated an intensive sampling program at the 20- and 800-m treatment lakes at LLB to test the impact of sampling frequency on estimates of summer means. The lakes were sampled weekly for phosphorus and chlorophyll a. The weekly sampling did not reduce the variability in the estimates of productivity for either lake, and was not continued. In 1997, we sampled the 12 lakes 6 times from May to September and 4 times (no zooplankton samples) over the 1997-98 winter. The 1995 and 1996 phytoplankton and zooplankton samples have been analyzed.

Sedimentation

Sediment traps in LLB20 were sampled weekly or bi-weekly in both 1996 and 1997. Traps placed in other lakes in 1997 were sampled when water chemistry was sampled. All samples have been

analyzed for organic and inorganic fractions. Annual and spatial comparisons of sedimentation have been completed for LLB20.

Macrophytes

The 1996 and 1997 samples have been sorted to species, dried and weighed. Annual comparisons in total biomass have been completed.

Leaf Litter

The 1996 and 1997 samples have been analyzed. Annual and harvest/leave comparisons in biomass have been completed.

Projected Work

The sampling program of the lakes will continue in summer 1998. Two years of pre- and post-treatment data will be analyzed to assess the impact of harvesting on nutrients and primary production. Analysis of the sediment and litter trap data will be completed over winter 1998 and this analysis will determine whether litter and sediment will be monitored in summer 1998.

Core Aquatic Program - Fisheries Section
Principal Investigator: Dr. W.M. Tonn

General Objectives and/or Hypotheses

Hypothesis 1 Changes in water, nutrient, POM, and sediment loads due to harvesting in riparian forest will affect biomass and species composition of primary producers, and, via bottom-up processes alter the distribution and abundance of higher trophic levels in the lake's food web.

Hypothesis 2 Changes in the distribution and abundances of fishes due to food web alterations and depletion on oxygen will alter lake ecosystem processes via top-down effects.

Variables Sampled

Each spring total population densities, size structures, and the relative abundance of fathead minnows in the SCL group of lakes is estimated by mark-recapture methods using minnow traps. In the summer species richness, relative abundance, size-structure and condition of each resident fish species is estimated with Lundgren multi-mesh survey gillnets and minnow traps with total fishing effort standardized for the size (area, depth) of the lake. The following variables are measured/calculated:

Length
Weight
Sex
CPUE

Distribution

Sampling Locations

Sampling sites for gill nets and minnow traps in each lake are chosen using a stratified random design. The number of nets and minnow traps varies with lake and is standardized for the size (area, depth) of the lake.

Progress to Date

The mark-recapture program has been conducted every year of the TROLS program starting in 1995. This involves an intensive examination of the four fathead populations inhabiting the TROLS SCL study lakes. The approach involves monitoring the demographic and life history characteristics of the fathead populations, food availability, and the basic limnology of the lakes for two years before and two years after harvesting. The pre-harvest monitoring of fathead populations will allow us to determine what factors contribute to natural inter-population and inter-annual differences, whereas post-harvest monitoring will allow us to assess the effects of forest harvesting on these populations. Pre-harvest results indicate a high degree of inter-population and inter-annual variation in population size and this variation appears to be linked to differences in lake productivity and over-winter oxygen levels. Given that it is predicted that forest harvesting will result in changes in nutrient loading, primary productivity, and winter oxygen depletion rates in lakes, forest harvesting could thus have a significant impact on fathead populations inhabiting small boreal lakes.

The gill net and minnow trap survey were conducted in 1995 and 1996. In 1996, the gillnet survey focused on the lakes with game fishes (LLB20, LLB800, SPH20, SPH200 and SPH800). There was no survey in 1997 due to budget constraints. The pre-treatment data (1995-96) have been entered into the database. Pre-treatment relative abundance, size structure and condition of most, but not all, fish species has been estimated Over the 1995-96 winter LLB800 suffered a severe winterkill. After ice-off specimens of northern pike, yellow perch and white sucker were collected for length and aging.. In both 1995 and 1996, richness of fish communities varied from 0-4 species. Mean catches in lakes with game fishes were similar in the two pre-treatment years (except for LLB800 due to winterkill). Variability of catch was much higher in 1996.

Projected Work

We will continue the mark-recapture and gillnet/minnow trap survey in 1998. The gillnet survey will occur on all 12 lakes. The data from 1998 will be used to assess the impacts of harvesting on fish communities.

Core Streams Program
Principal Investigators: Drs. P. Chambers, J. Culp and F. Wrona

General Objectives and/or Hypotheses

Hypothesis 1: Forest removal by timber harvesting and fire wildfire will have bottom-up effects on boreal stream ecosystems that operate via trophic linkages

Hypothesis 2: The destabilizing effects of forest removal will increase spatial and temporal variability in both the abiotic and biotic components of impacted streams

Hypothesis 3: Forested riparian buffer strips are important for the preservation of boreal streams ecosystem structure and function

Hypothesis 4: The effects of timber harvesting versus wildfire on boreal stream ecosystems will be similar in direction; the degree of response, however, will depend upon the intensity and magnitude of forest cover removal

Variables Sampled

Harvest Streams

Physical - stream temperature, discharge, sediment load, bankfull width, bankfull depth, substrate size and embeddedness, canopy cover
Chemical - TP, TDP, SRP, NO_3+NO_2, NH_3, TDN, TKN, TN, Particulate N, DOC, DIC, Particulate C, NA, Ca, Mg, K, Cl, SO_4, Conductivity, TDS, TSS, Color, Total Alkalinity
Biological - periphyton, bryophytes, benthic invertebrates

Fire Streams

Physical - stream temperature, discharge
Chemical - TP, TDP, SRP, NO3+NO2, NH4, TDN, TKN, TN, Particulate N, DOC, DIC, Particulate C, NA, Ca, Mg, K, Cl, SO4, Conductivity, TDS, TSS, Color, Total Alkalinity
Biological - periphyton

Sampling Locations/Progress to Date

The harvest streams are sampled immediately upstream and downstream of each cutblock. The fire study streams are sampled at specific locations. The harvest streams were sampled throughout the summer (1996-1997) and once in the fall (1995-1997); not all variables were sampled on each trip in the summer. The fire streams were sampled periodically throughout the summer (1995-1997); not all variables are sampled on each trip.

Projected Work

We will continue to process samples and analyze the 1997 data. Continued sampling on the harvest and fire streams is contingent on funding.

GRADUATE STUDENTS

There are currently 21 graduate students working within four disciplines (Table 3). Two students have completed their studies, while 4 more are expected to begin during the 1998 field season. We are attempting to draw a post-doctoral fellow to work on the integration of TROLS data, but as yet have been unsuccessful in locating a qualified applicant.

WORKSHOPS AND MEETINGS

The TROLS Principal Investigators and core staff hold monthly meetings to discuss the ongoing operation of the project. These meetings often include representatives from our government and industry partners, graduate students and members of the public. Summary notes are taken and distributed to all those involved with the operation of the project.

Workshops are held semi-annually and are an integral part of TROLS. They allow our research group, staff, industry and government partners, students, and interested public to share and exchange information on the project and on forest management in general. They are often used as a forum to update partners on how the project is progressing and what directions we are taking. Guest speakers are often invited to give presentations on landscape level research in other parts of Canada and the United States, and to inject fresh insights into TROLS.

We held two workshops during the 1997/98 project year. On December 8, 1997 we held an internal scientific workshop (agenda and list of attendees in Appendix) designed to update all P.I.'s on progress from the previous summer and to begin the process of integrating the data from individual research programs into the whole. Over 30 people were in attendance. On February 20 and 21, 1998 we held our second workshop entitled "Harvesting and buffer strips: Implications for policy and practices" (agenda and list of attendees in appendix). This workshop focused more toward the directions TROLS must consider for its final two seasons of post-harvest data collection. TROLS partners in attendance were asked to give their own feedback on what types of products they hope to see from our research and what forms they would like to receive them in. A very successful student poster session was also included to update everyone on the vast range of studies supported by TROLS.

We are committed to the workshop process and will be running two more workshops during the 1998-99 project year. These will be directed toward presentation of results of post-treatment data and preliminary recommendations to partners. Our second workshop will include a public forum. In addition, we expect to run a scientific team retreat in January of 1999 to implement data integration and make plans for the final field season.

Table 3. TROLS Graduate Students (* indicates completed thesis)

Student	Degree Sought	Start Date	End Date	Supervisor	Project Title
N. Armstrong	M.Sc.	May 1997	Dec. 2000	Prepas, Planas	"Current and historic patterns in phytoplankton community structure"
C. Beaudoin*	M.Sc.	Sept. 1995	Jan 1998	Prepas, Tonn, Wassenaar (NHRI)	"Characterization of the food webs in eight lakes of Alberta's boreal forest based on stable isotopes"
C. Bouffard	M.Sc.	Jan. 1997	Dec. 2000	Pinel-Alloul	"Zooplankton species dynamics in 20- and 800-m treatment lakes: pre- and post-harvest"
E. Braun	Ph.D.	Sept. 1995	Dec. 2000	Prepas, Planas	"Impact of land-clearing practices on cyanobacterial populations and toxin production"
C. Burgess*	M.Sc.	Jan. 1996	July 1997	Macdonald, Boutin	"The uniqueness of riparian forests - a stand to landscape-level approach"
N. Carmosini	M.Sc.	June 1996	Dec. 1999	Prepas, DeVito	"Nitrogen cycling with disturbance"
A. Danylchuk	Ph.D.	May 1995	Dec. 2000	Tonn	"Factors regulating population structure and life history characteristics of fathead minnows in boreal Alberta lakes: the role of intraspecific interactions and the effects of forest harvesting"
J. DeGroot	M.Sc.	Sept. 1997	Dec. 2000	Boutin, Macdonald	"Riparian corridor use by ungulates and mammalian predators"
C. Dillabaugh	M.Sc.	Sept. 1997	Sept.. 1999	Creed, Devito	" An expert system for classifying the susceptibility of lakes in the western boreal forest to eutrophication.
B. Eaton	Ph.D.	Jan. 1996	Dec. 2000	Paszkowski	"Effects of forest clearing on wood frog population dynamics"
J. Evans	M.Sc.	Sept. 1995	Aug. 1998	Prepas, Rothwell, Creed	"Effects of forest harvesting on nitrogen and phosphorus in the subsurface flow around three western boreal lakes"
A. Ghadouani	Ph.D.	Jan. 1996	Dec. 2000	Pinel-Alloul, Prepas	"Interactions between filamentous and colonial cyanobacteria and zooplankton: comparative and experimental approaches"

Table 5 Continued

Student	Degree Sought	Start Date	End Date	Supervisor	Project Title
K. Harper	Ph.D.	Sept. 1995	Aug. 1999	Macdonald	"Effects of natural and created edges on forest structure and composition"
D. Lambert	M.Sc.	May 1996	Dec. 1998	Hannon	"Effects of forest harvesting on territory defence and reproductive success of ovenbirds"
P. Langlois	M.Sc.	May 1996	Dec. 1999	Prepas	"Benthic macroinvertebrate community response to catchment area clearcut in the boreal plains"
A. Patoine	Ph.D.	Jan. 1995	May 1999	Pinel-Alloul, Prepas	"Annual variation in size structure, composition and biodiversity of zooplankton during the pre-deforestation years (1994-96)"
S. Peters	M.Sc.	Jan 1998	Dec 2000	Macdonald, Boutin	"Impact of herbivory on redevelopment of plant communities in cutblocks"
J. Pierre	Ph.D.	Jan. 1996	Dec. 2000	Paszkowski	"Effects of disturbance on aquatic bird assemblages in the western boreal forest"
P. Presant	M.Sc.	Jan. 1996	Aug. 1999	Macdonald	"Effects of natural and created edges on forest microclimate and soil nutrient and water relations"
M. Veliz	M.Sc.	Sept. 1995	May 1998	Culp, Prepas, Chambers	"Timber harvesting and its effects on macroinvertebrate resource utilization"
I. Whitson	M.Sc.	May 1996	Dec. 1999	Prepas, Creed	"The soil-water interface in a disturbed landscape"
Unknown	Ph.D.	Sept. 1998	Dec. 2000	Hannon	"Buffer strips as movement corridors for resident winter birds"
Unknown	M.Sc.	Sept. 1998	Dec. 2000	Creed, Prepas, Chambers	"N & P dynamics along a hydrological continuum"
Unknown	Ph.D.	Sept. 1998	Dec. 2001	Creed, Devito	"Scale water and nutrient fluxes from transects to basins"
Unknown	Ph.D.	May 1998	Dec. 2000	Tonn, Prepas	"Effects of forest harvesting on food web structure and trophic interactions in boreal Alberta lake ecosystems"

WEB SITE

We entered the world wide web with a very simple site in the fall of 1997 and it has been expanding constantly since that time. It is now one of our primary methods of promotion of the project. The site, located at http://www.biology.ualberta.ca/trols/trolweb.html, provides general information about the project, the P.I.'s, staff and students. In addition it provides updates on TROLS activities such as workshops and employment opportunities within the project are posted. Future work will include links to our industry partners and related studies. Once security details are worked out, future steps will include the placement of data and results on either this website, a new site or an FTP site.

CONFERENCE PRESENTATIONS AND PUBLICATIONS

TROLS spends great energy in presenting its work to forums across Canada. Our production of written publications has been small to date, but is expected to increase quickly once a second season of post-treatment data is in hand. A large step toward the production of future publications was the development of a confidential internal report summarizing general information on the TROLS study sites, personnel, and research projects. As it contains unpublished data, this report is made available only to TROLS P.I.'s and partners., and will be used as a resource for building integrated papers and publications. It will be updated on a yearly basis.

Conference Presentations/Abstracts

Braun E.M., E.E. Prepas, Ghadouani A., and B. Pinel-Alloul. Can nutrient inputs increase toxin-producing cyanobacteria biomass and stimulate toxin production by cyanobacteria in eutrophic boreal lakes? Limnocorral experiments.. Presented at the Society of Canadian Limnologists, Ottawa, 2-4 January 1997.

Braun E.M., E.E. Prepas, Ghadouani A., and B. Pinel-Alloul. Can nutrient inputs increase toxin-producing cyanobacteria biomass and stimulate toxin production by cyanobacteria in eutrophic boreal lakes? Limnocorral experiments. Presented at the Prairie University Biology Students, Edmonton, February 1997.

Burgess, C.J., S.E. Macdonald, and S. Boutin. 1997. Patterns of wildfire history and forest composition in the western boreal mixedwood: a broader context for forest resource management. AIBS 48th Annual Meeting, August 3-7, 1997, Montreal, QC.

Eaton, B. R., and C. A. Paszkowski. June 29, 1997. Response of boreal wood frog (*Rana sylvatica*) populations to habitat disturbance (poster). American Society of Ichthyologists and Herpetologists, University of Washington, Seattle, Washington.

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Eaton, B. R. November 9, 1996. Response of amphibian populations to habitat modification in boreal Alberta. 1st Annual Department of Biological Sciences Graduate Student Research Symposium, University of Alberta, Edmonton, Alberta.

Eaton, B. R., C. A. Paszkowski, and C. Grekul. October 6, 1996. Effects of habitat modification on amphibian populations in boreal Alberta. 6th Annual Meeting of the IUCN/SSC Task Force on Declining Amphibian Populations in Canada (DAPCAN), University of Calgary, Alberta.

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Ghadouani A., B. Pinel-Alloul, Braun E.M., and E.E. Prepas. Ecological and toxicological effects of increasing cyanobacteria biomass on zooplankton communities in eutrophic lakes: limnocorral experiments. Presented at the Society of Canadian Limnologists, Ottawa, 2-4 January 1997.

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Paszkowski, C.A. Poster - Canadian Society of Limnologists, Montreal PQ. January 1996.

Paszkowski, C.A. Poster - Research Revelations '96, Edmonton AB. February 1996.

Paszkowski, C.A. Presentation - IUCN/SSC Task Force on Declining Amphibians Populations in Canada, Calgary AB. October 1996.

Paszkowski, C.A. Poster - Ecological Society of America, Albuquerque NM. August 1997.

Paszkowski, C.A. Poster - Midwest Fish & Wildlife Conference, Milwaukee WI. December 1997.

Pinel-Alloul B., C. Bouffard and G. Methot. Zooplankton communities in Alberta lakes (TROLS Program): natural state before harvesting. SCL annual meetings, Kingston, Ontario, Jan. 1998

Prepas, E.E. 1995. Lakes and forestry: pioneering research in Alberta and the TROLS program. Fourth Annual ALMS Workshop. Lac La Biche, Alberta, 30 September 1995

Prepas, E.E. 1995. The aquatic portion of forest management in the western boreal forest - the TROLS experiment. Ecosystem Management. Prince George, May 30, 1995

Prepas, E.E. 1996. Integrating forest harvesting to maintain aquatic ecosystem integrity. Alberta Lake Management Society, Sylvan Lake, Alberta, September 1996

Prepas, E.E. 1996. Integrating forest harvesting to maintain aquatic ecosystem integrity. North American Lake Management Society, 16th Annual International Symposium, Minneapolis, MN, November 1996

Prepas E.E. 1997. Impact of disturbance in the drainage basin on water quality in lakes in the western boreal forest - with potential treatment strategies. ANSWER '97 Conference, Nanjing China, July, 1997

Reedyk, S. 1997. Roles of buffer strips in riparian zones. Forest Explorers 97. Boreal Forest Research Fair, Manning, Alberta, 17 October 1997

Veliz M., Mayfly (Ephemeroptera) diet and density in boreal streams: responses to logging. (Poster) Prairie University Biology Symposium, University of Alberta, Edmonton, Alberta, February 1997.

Veliz M. Does timber harvest result in nutrient enrichment in mixed wood boreal streams? Society of Canadian Limnologists, Kingston, Ontario, January 4, 1998.

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Beaudoin, C. 1998. Stable Isotope Study of Food Webs in Lakes of Alberta's Boreal Forest. Department of Biological Sciences, University of Alberta. unpublished M.Sc. thesis.

Burgess, C. 1997. Forested Landscape Patterns in the Western Boreal Mixedwood Forest of Alberta: Riparian Forests, Fire History, Canopy Composition and Topography. Department of Biological Sciences, University of Alberta. unpublished M.Sc. thesis.

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Eaton, B. R., and C. A. Paszkowski. 1997. Wood frog population response to buffer strip width in riparian zones in the boreal forest of Alberta. Final Report to the Canadian Circumpolar Institute. 8 pages.

Pinel-Alloul, B., G. Methot, A. Patoine, C. Bouffard, and V. Michard. 1996. Zooplankton community structure in the TROLS lakes. Summer 1995: first pre-deforestation year.GRIL. Departement de Sciences Biologiques, Universite de Montreal.

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CONCLUSION

The past year has seen the TROLS project successfully complete its first year of post-harvest sampling. Tremendous effort was expended to achieve this, both through the renewal of our program with NSERC and our industry partners, and through the hard work of our researchers, technical staff, students and field personnel. With the first season of post-harvest data now archived, we are poised to begin in depth analysis of this information which will ultimately lead to the production of valuable results.

The upcoming year will not only see us continue with our sampling programs, but also begin the process of disseminating our results. This will be achieved through our workshops, expansion of our web site, and the production of publications.

APPENDIX

- TROLS Brochure
- TROLS Web Site Home Page
- Agenda for TROLS Fall'97 Workshop
- Attendees at TROLS Fall'97 Workshop
- Agenda for TROLS Spring'98 Workshop
- Attendees at TROLS Spring'98 Workshop

Welcome To The TROLS Webpage

Terrestrial and Riparian Organisms, Lakes, and Streams

The TROLS study is the first and most comprehensive study ever undertaken to investigate the full implications of forested buffer strips on the conservation of both aquatic and terrestrial communities in northern Alberta. Now in its fourth year, this 6 year project, based at the University of Alberta, includes 13 principal investigators from 4 institutions across Canada and 4 full time technicians. In addition, TROLS will provide training to 24 graduate students 2 post-doctoral fellows and provide employment and field research training to over 100 research assistants.

- **TROLS and its mission**
- **Principal Investigators, Staff and Graduate Students**
- **TROLS Pictures**
- **Events**
  - **MSc Thesis Seminar**
  - **TROLS "Spring '98" Workshop**
- **Employment Opportunities**

TROLS is based in the Biological Sciences Department at the University of Alberta. Our logistical base is the Meanook Biological Research Station, near Athabasca, Alberta.

- **Meanook Biological Research Station**
- **Biological Sciences Home Page**
- **University of Alberta**
- **Email the TROLS Office**
- **TROLS Updates**

You are visitor number 436 to visit this site since 13 January 1998.

Any ideas for the TROLS webpage?? Contact Warren or Mark!!!

This site was last updated on 19 March 1998.

TROLS FALL WORKSHOP
08 December 1997
CW313 Biological Sciences Centre

Agenda

A. Overview of research plan, anticipated and known results

8:30 **Terrestrial**
- Vegetation - Ellen Macdonald
- Amphibians - Brian Eaton
- Small Mammals - Stan Boutin
- Birds - Stan Boutin
- Internal Integration - Stan Boutin
- Opportunities for integration with hydrology - Ellen Macdonald

9:45 **Hydrology** - Kevin Devito/Irena Creed
- Hydrology Overview
- Opportunities for integration with terrestrial
- Opportunities for integration with lakes

10:30 BREAK

10:45 **Streams** - Patricia Chambers
- Streams Overview
- Internal Integration
- Opportunities for integration with lakes

11:30 LUNCH
Served in Room G217, Biological Sciences

12:30 **Lakes**
- Water Quality - Ellie Prepas
- Phytoplankton / Hydrology Linkages - Ellie Prepas
- Zooplankton - Bernadette Pinel-Alloul
- Vertebrates - Johanna Pierre & Sharon Reedyk
- Internal Integration - Ellie Prepas & Bernadette Pinel-Alloul
- Opportunities for integration with Hydrology - Ellie Prepas
- Opportunities for integration with Streams - Ellie Prepas

2:15 **General Discussion**:
- Integration
- Role of the Postdoctoral Fellow

2:45 BREAK

B. Actio.. .ems

3:00
1. **Publications**
2. **Opportunities for publication:** Conference proceedings, new ecological journals
3. **TROLS Annual Report for 1997-98**
4. **Spring Workshop**

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2:15 **General Discussion**:
- Integration
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2:45 BREAK

B. Action Items

3:00
1. **Publications**
2. **Opportunities for publication:** Conference proceedings, new ecological journals
3. **TROLS Annual Report for 1997-98**
4. **Spring Workshop**

Attendees at TROLS Fall'97 Workshop

Researchers:
Stan Boutin, U of A
Patricia Chambers, NHRI
Kevin Devito, U of A
Ellen Macdonald, U of A
Bernadette Pinel-Alloul, U de Montréal
Ellie Prepas, U of A
Richard Rothwell, U of A

Technical Staff:
Matt Dance, U of A
Andy McAllister, U of A
Sharon Reedyk, U of A
Mark Serediak, U of A
Warren Zyla, U of A

Students:
Nicole Armstrong, U of A
Catherine Beaudoin, U of A
Elizabeth Braun, U of A
Nadia Carmosini, U of A
Andy Danylchuk, U of A
Jordan DeGroot, U of A
Craig Dillabaugh, U Victoria
Brian Eaton, U of A
Jeanette Evans, U of A
Karen Harper, U of A
Pete Langlois, U of A
Johanna Pierre, U of A
Peter Presant, U of A
Mari Veliz, U of A
Ivan Whitson, U of A

Government and Industry:
Brian Kotak, Alberta-Pacific
Joe Neiderleitner, Alta. Environmental Protection

Public:
Sven-Erik Jansson

Attenedees at TROLS Spring'98 Workshop

Researchers:
Patricia Chambers, NHRI
Al Curry, U. of New Brunswick
Irena Creed, U Victoria
Joseph Culp, NHRI
Kevin Devito, U of A
Susan Hannon, U of A
Ellen Macdonald, U of A
Art McKee, Oregon State U.
Ellie Prepas, U of A
Richard Rothwell, U of A
Uldis Silins, U of A

Technical & Research Staff:
Matt Dance, U of A
Beverly Gingras, U of A
Andy McAllister, U of A
Kate Murie, U of A, MBRS
Brett Purdy, SFM-NCE
Mark Serediak, U of A
Ainsley Sykes, U of A
Kim Westcott, U of A
Jay White, SFM-NCE
Warren Zyla, U of A

Students:
Nicole Armstrong, U of A
Catherine Beaudoin, U of A
Elizabeth Braun, U of A
Nadia Carmosini, U of A
Andy Danylchuk, U of A
Jordan DeGroot, U of A
Craig Dillabaugh, U Victoria
Brian Eaton, U of A
Jeanette Evans, U of A
Anas Ghadouani, U de Montréal
Karen Harper, U of A
Pete Langlois, U of A
Johanna Pierre, U of A
Peter Presant, U of A
Mari Veliz, U of A
Ivan Whitson, U of A

Public:
Sven-Erik Jansson
Orrin Stephen

Government and Industry:
Dave Beck, Ainsworth Lumber Co.
Dave Borutski, Alta. Environmental Protection
David DeRosa, Fish and Wildlife
Gerry Haekel, Alta. Public Lands
Mark Heckbert, Alta. Fish and Wildlife
Brian Kotak, Alpac
Mike MacKinnon, Syncrude
Lui Marinelli, Alta. Research Council
Joe Neiderleitner, Alta. Environmental Protection
Travis Ripley, Alberta Conservation Assoc.
Ed Sager, Alpac
Nancy Scott, Streamline Consulting
Dennis Quintilio, Alta. Environmental Protection
Trevor Thera, Alberta Conservation Assoc.
Dave Walty, Alta. Natural Resource Services